Ion Mass Spectrometer for Heliospheric Missions

Completed Technology Project (2013 - 2018)

Project Introduction

We are developing and IMS that can be used to measure the solar wind ion composition and measure interstellar pick up ions. This instrument will support a future heliospheric missions that measures fast neutrals from the outer boundaries of the solar wind. This instrument will have unique ion composition capabilities and will be designed to work in the transient energetic particle events such as Corotating Interaction Regions (CIRS), Coronal Mass Ejections (CMEs) and Solar Energetic Particle (SEP) events. In addition, the IMS can be used for planetary missions including missions with high radiation environment such as Io and Europa.

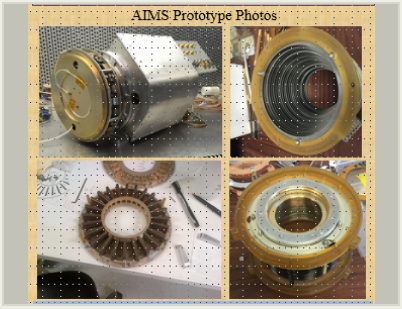
We are developing this instrument based on an ongoing development effort, completing 9.5-27 MeV irradiation tests of microchannel plate (MCP) shielding designs, and ion beam testing the instrument's tapered linear electric field time-of-flight section using the Suprathermal Ion Mass Spectrometry Lab at Goddard for ion energies from 100 V to 15 kV. We have also shown that the Circular Wien Filter with tophat Electrostatic Analyzer works successfully from 50 V to 10 kV.for a wide range of ion mass per charge (M/Q).

Anticipated Benefits

Results will allow one to correctly model background from penetrating energetic particles into lower energy particle instruments from such missions as Galileo, Cassini, Van Allen Probes and the Europa Multiple Flyby Mission (EMFM).

Will allow one to properly design and shield low energy particle instrumentation against penetrating particles for future missions to the inner heliosphere and the planetary magnetospheres of Jupiter, Saturn, Uranus and Neptune.

Will allow one to design spacecraft and their instrumentation that must operate within the radiation belts of the Earth. This includes particle and photon counting detectors. In addition, IMS would be useful for in-situ resource utilization (ISRU) and space mining applications to assay abundances of water and high-demand trace elements.



AIMS Prototype Heliospherical and Planetary Missions

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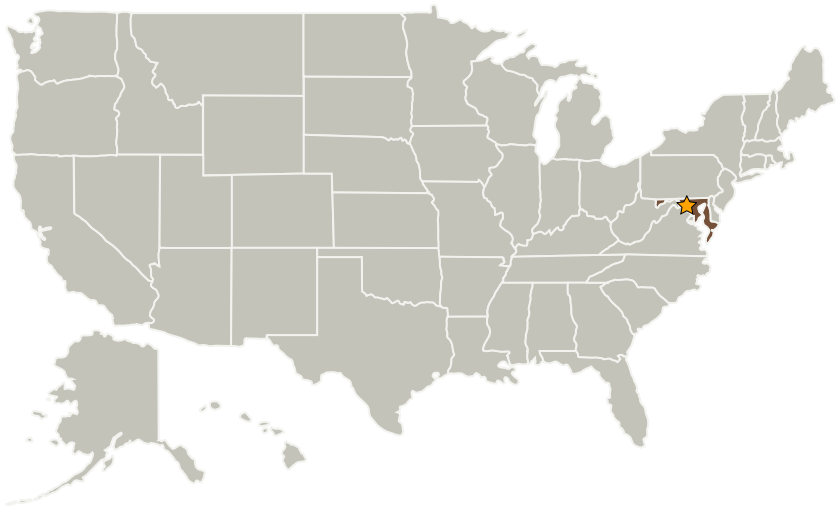
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Co-Funding Partners	Type	Location
National Institute of Standards and Technology(NIST)	US Government	Boulder, Colorado

Primary U.S. Work Locations
Maryland

Project Transitions

October 2013: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Manager:

Nikolaos Paschalidis

Principal Investigator:

Edward C Sittler

Co-Investigators:

John F Cooper
Nikolaos Paschalidis

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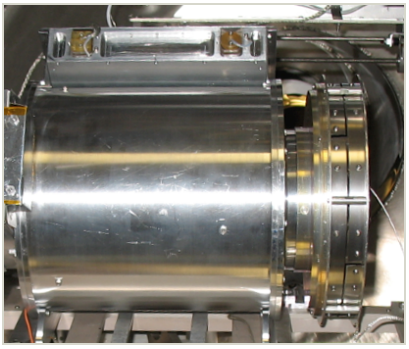
September 2018: Closed out

Closeout Summary: The purpose of the Goddard Space Flight Center's Internal Research and Development (IRAD) program is to support new technology development and to address scientific challenges. Each year, Principal Investigators (PIs) submit IRAD proposals and compete for funding for their development projects. Goddard's IRAD program supports eight Lines of Business: Astrophysics; Communications and Navigation; Cross-Cutting Technology and Capabilities; Earth Science; Heliophysics; Planetary Science; Science Small Satellites Technology; and Suborbital Platforms and Range Services. Task progress is evaluated twice a year at the Mid-term IRAD review and the end of the year. When the funding period has ended, the PIs compete again for IRAD funding or seek new sources of development and research funding or agree to external partnerships and collaborations. In some cases, when the development work has reached the appropriate Technology Readiness Level (TRL) level, the product is integrated into an actual NASA mission or used to support other government agencies. The technology may also be licensed out to the industry. The completion of a project does not necessarily indicate that the development work has stopped. The work could potentially continue in the future as a follow-on IRAD; or used in collaboration or partnership with Academia, Industry and other Government Agencies. If you are interested in partnering with NASA, see the TechPort Partnerships documentation available on the TechPort Help tab. http://techport.nasa.gov/help

Images



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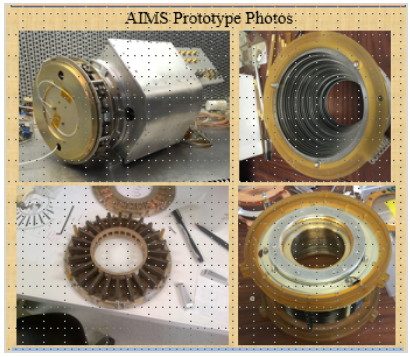
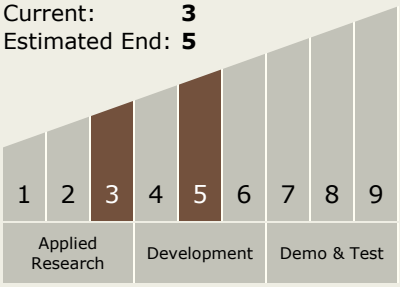
Project Image ROE 252 HP Penetrating Radiation Mitigation Designs for IMS used near Jupiter Icy Moons Europa and Ganymede
(https://techport.nasa.gov/image/36892)



AIMS Prototype Heliospherical and Planetary Missions
AIMS Prototype Heliospherical and Planetary Missions
(https://techport.nasa.gov/image/36895)

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **5**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.3 In-Situ Instruments and Sensors
    - TX08.3.1 Field and Particle Detectors

Other/Cross-cutting:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes
- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.3 Simulation
    - TX11.3.1 Distributed Simulation

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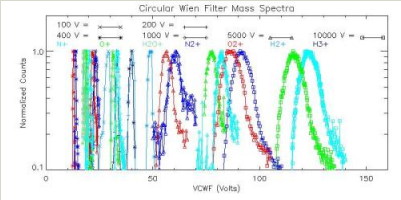

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(https://techport.nasa.gov/image/36896)

Project Website:

https://www.facebook.com/NASA.GSFC

Target Destinations

The Sun, Others Inside the Solar System